CERES Objectives, Goals, Requirements

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CERES (PIs Barkstrom, Wielicki)
- Observe SW, LW, Window (WN) TOA fluxes
- Retrieve clouds with imager
- Estimate Surface and Atmospheric Radiation Budget (SARB)
  - SARB = vertical profile SW(z), LW(z), WN(z)
  - Adjust parameters
    - Cloudy: cloud (τ , z, area)
    - Clear: ocean aerosol τ or land surface albedo
      humidity (PW, UTH) and surface skin T

CERES Goals for CLAMS

1. Validate vertical flux profile

2. Improve a priori ocean optics

Q: Why have COVE (long-term sea platform at Chesapeake Light)?

A1: Point (i.e., COVE) sea observations permit time mean closure for both **upwelling** and **net** surface radiation over a large area (at least MODIS pixel, and perhaps CERES footprint).

For surface upwelling, the above is hardly ever true over land. Over the sea, the ceaseless waves permit the analyst to swap space and time.

A2: Improved optical boundary conditions for remote sensing are needed for the most common surface (the sea) viewed from space.

Example: Direct radiative forcing of aerosols

A2 surface optics	>> retrieve aerosols
A1 surface net flx	>> parse forcing to surface vs atmos.

Q: What's special about COVE?

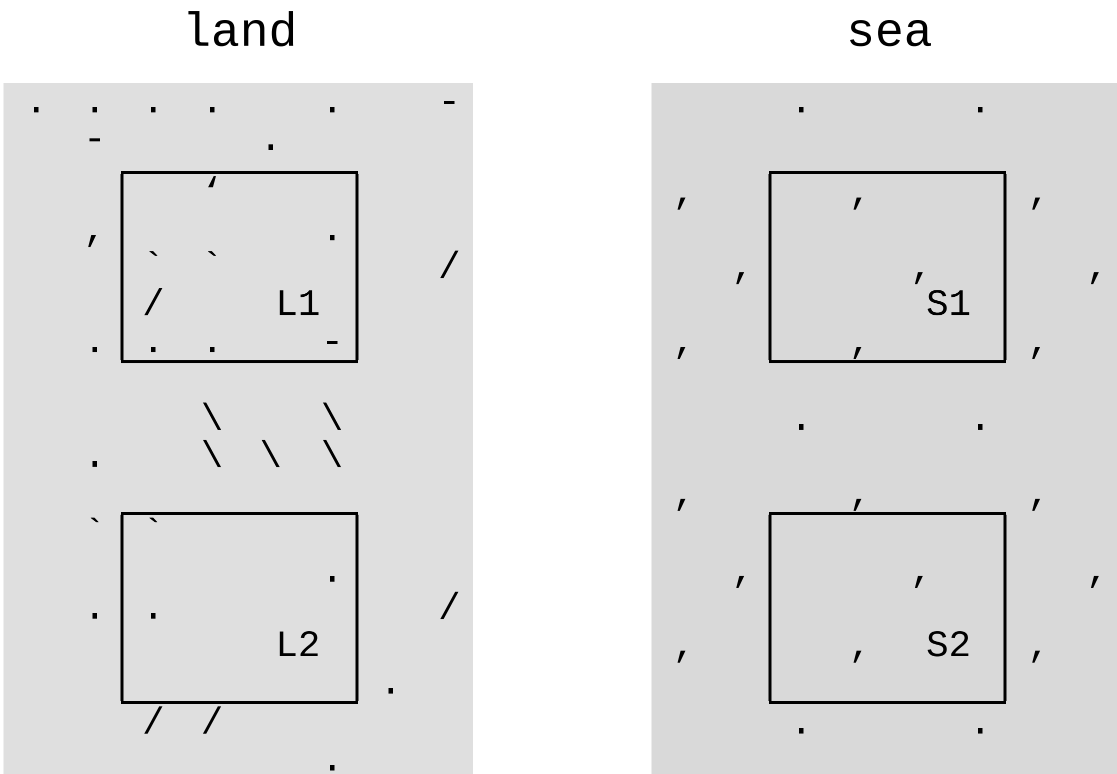
A: It will permit us to measure the variation of ocean optics for a huge number of sun angles, aerosol and cloud conditions, wind speeds, and sea states.

Q: What will the CLAMS campaign do for the long-term COVE?

A: CLAMS will determine how to account for platform obstructions and local variations in sea optics when interpreting COVE data.

Upwelling spectral radiances will be measured in ACE-Asia on RV Brown.

Observations of upwelling SW at 4 surface sites (2 land and 2 sea)



Land (L): Even if L1 and L2 are nearby, the time-mean upwelling radiation at L1 will differ from L2 (effect of trees, hills, etc.)

Sea (S): S1 and S2 are nearby, the time-mean upwelling radiation at S1 and S2 will be equal (swap space and time with ocean waves).

CLAMS – Aerosols, sea optics, and SW in clear skies

Ocean spectral BRDF – one focus of CLAMS

COVE - long time series of reflected spectral radiances (SP1A)
Simultaneous wind, wave height, aerosol τ, broadband (BSRN)

Variation of COVE sea BRDF w.r.t. winds, sea state, incoming SW, clouds

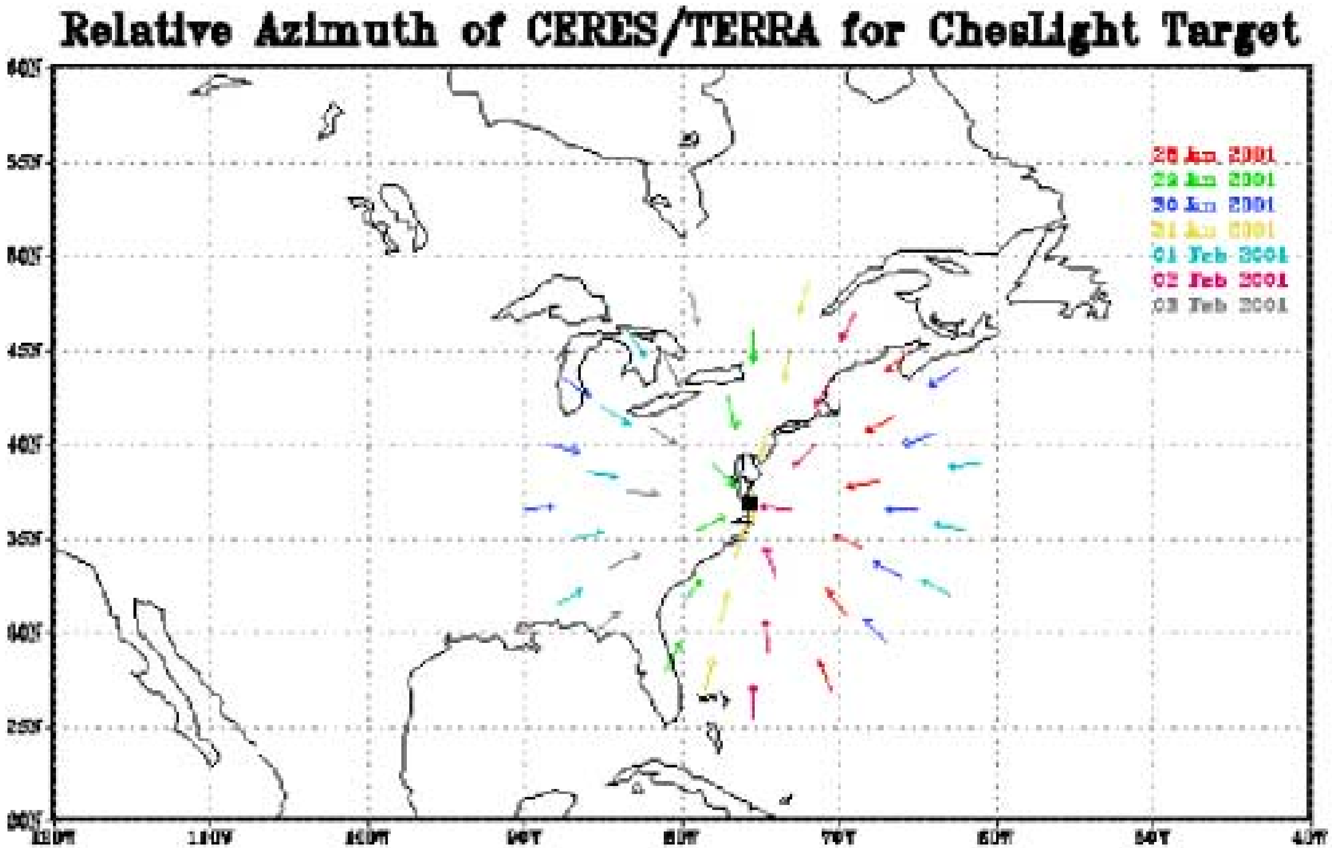
CLAMS – intensive aircraft field campaign (July 2001)

Scale up COVE measurements to MODIS (1 km) and CERES (15 km) pixels

ACE-Asia cruise of RV Brown (March-April 2001) - spectral radiances (SP1A)

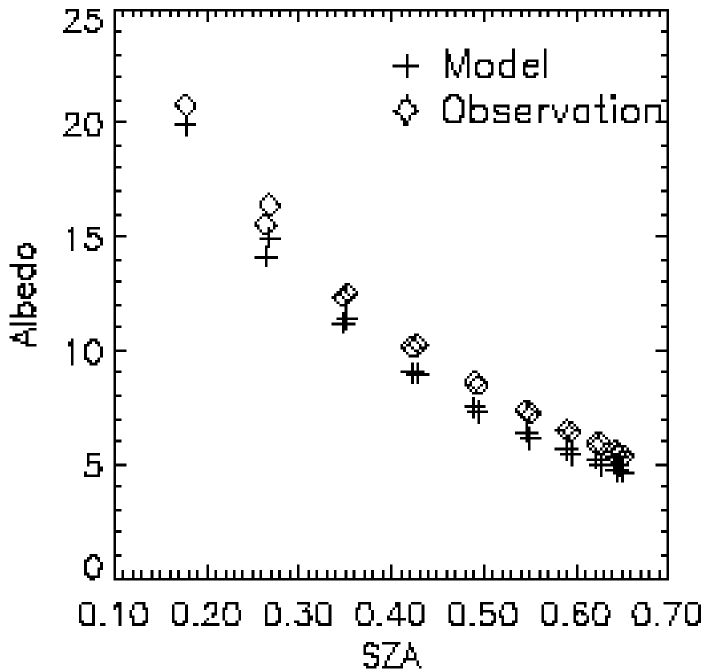
"Blue water" sea optics for a few wind and sea state conditions

A model of ocean optics cannot be validated with only measurements in the deep ocean from a research vessel (RV). The vessel rocks, and its time sampling is too short to span the myriad of sea state, wind, and sky conditions that drive sea optics. Our strategy is to obtain the exhaustive measurements we need by continuous operations at the rigid COVE platform. Aircraft measurements in CLAMS will validate our scaling up of the point data from COVE to the pixels of AVHRR, SeaWiFS, MODIS, MISR, and CERES (i.e., how to use satellite data to specify ocean BRDF). We will validate the final CLAMS results by comparing our satellite-based estimates of sea optics with measurements taken by the RV Brown over the Pacific Ocean during ACE Asia.



Reprogramming CERES scan for CLAMS (Haeffelin)

CERES can rotate in the azimuth plane to obtain numerous observations (at different view angles) of a single target on selected dates.

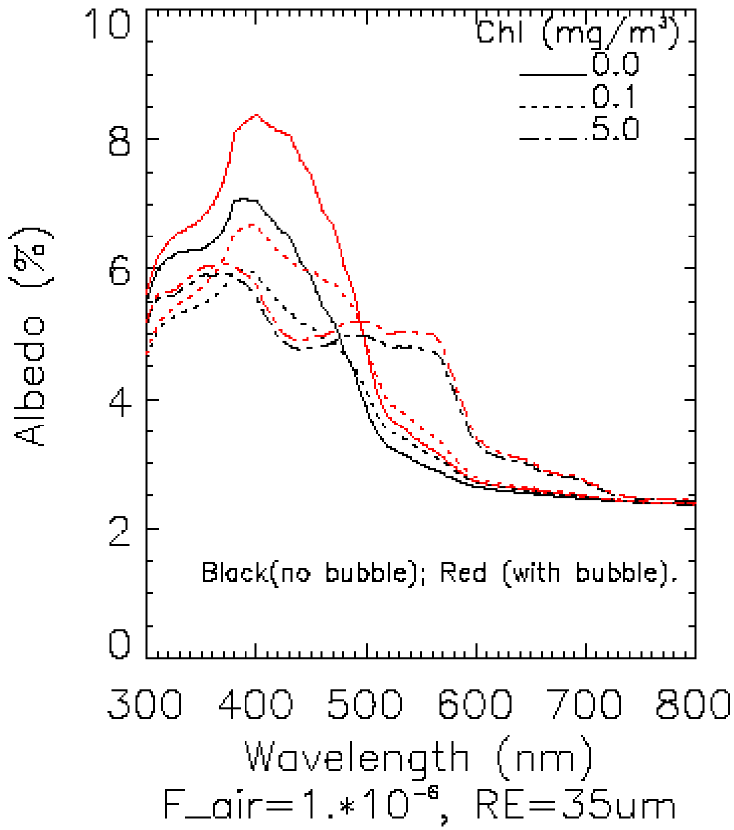


Broadband surface albedo – model and observations

Coupled ocean-atmosphere radiative transfer model (Z. Jin)

has explicit treatment of scattering within both air and sea

Observations at CERES Ocean Validation Experiment (COVE) sea platform



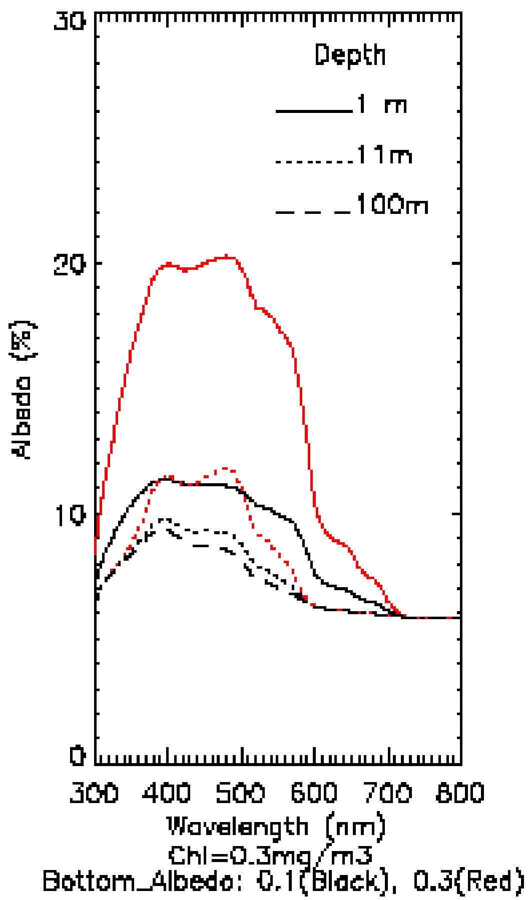
(Jin)

Ocean spectral albedo is influenced by several variables.

Chlorophyl typical sea concentration is 0.3 mg m-3

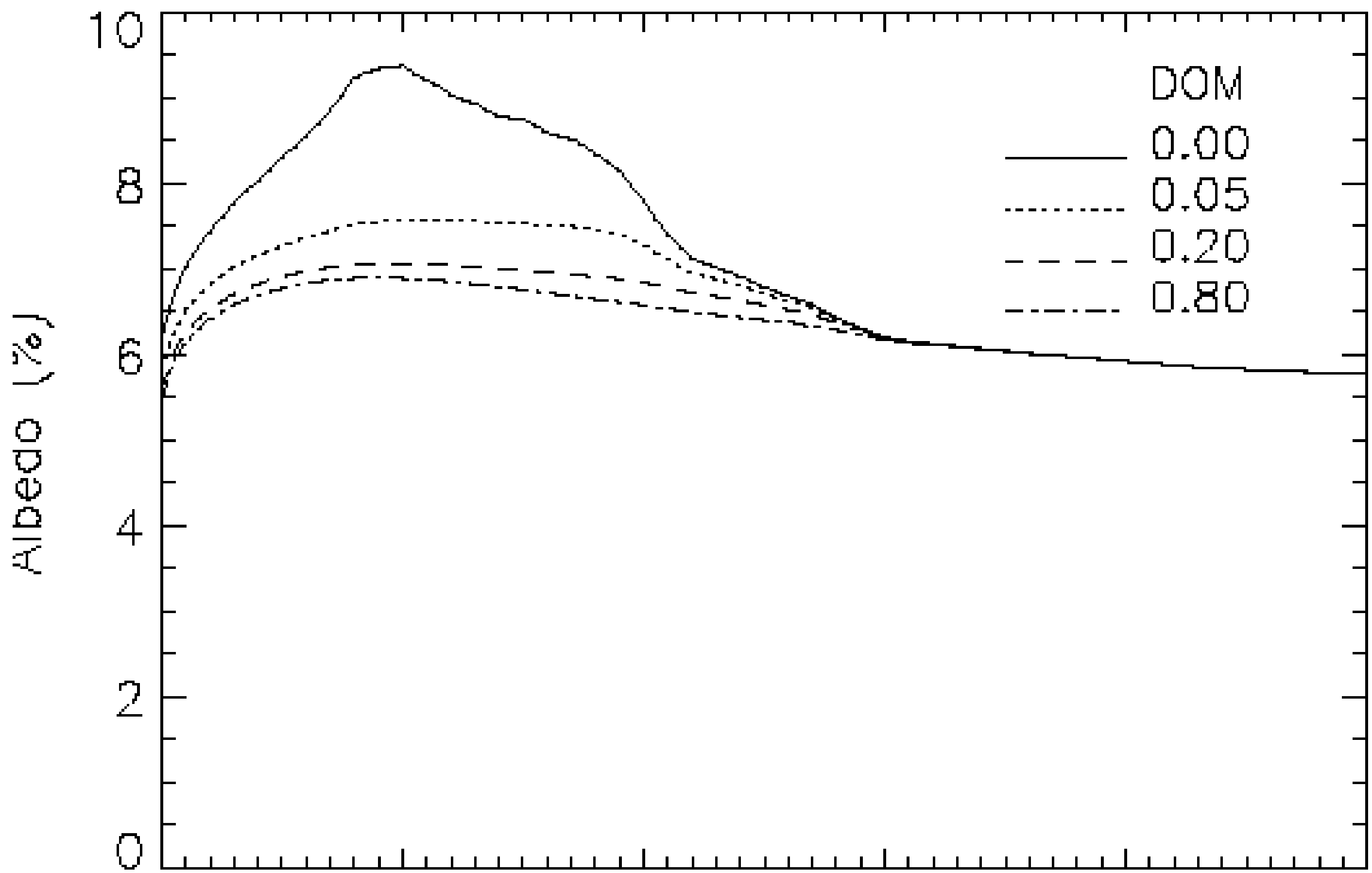
varies seasonally at COVE by ~factor 10

Bubbles definitely in the sea, but rarely accounted



(Jin)

Sea depth at COVE is 11m. We never see the bottom at COVE, but depth may be a factor for albedo. Bottom albedo is not measured.

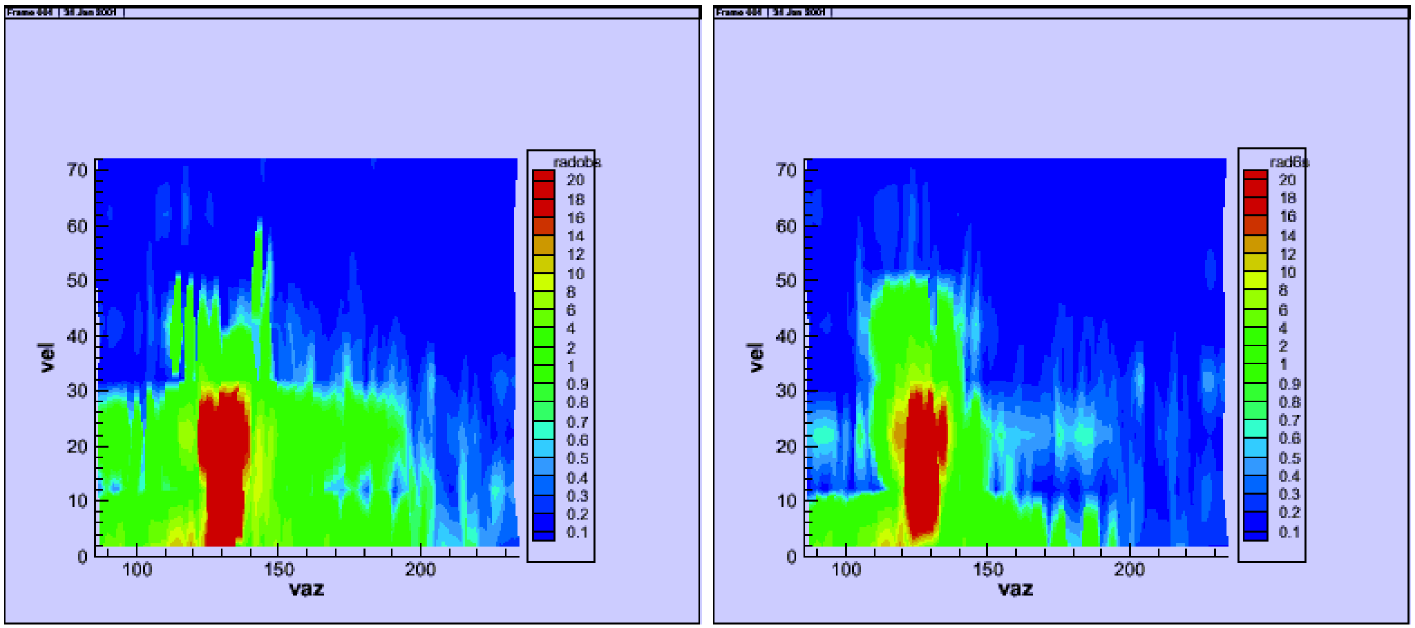


Modeled effect of Disolved Organic Matter (DOM) on spectral albedo

Radiance (uW/cm2/um/sr) for 2001-007 16GMT from 5-minute average.

SZA from 61.39 to 61.18, SAA from 161.72 to 162.56(±180).

Average wind speed is 5.8 m/s and direction at 163.7. AOD is 0.151.



Upwelling Directional Radiances - Observations and Model (W. Su)

SP1A (500nm)
Scanning photometer at COVE

6S Code
Widely used model